UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

September 30, 1991

NRC INFORMATION NOTICE 91-62: DIESEL ENGINE DAMAGE CAUSED BY HYDRAULIC LOCKUP RESULTING FROM FLUID LEAKAGE INTO CYLINDERS

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the possibility of severe damage to the emergency diesel generator (EDG) engine caused by hydraulic lockup resulting from fluid which has leaked into cylinders of the diesel engine. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On June 16, 1991, during a precautionary check in preparation for a routine surveillance test of a Unit 2 emergency diesel generator (EDG), Southern California Edison, the licensee at the San Onofre Nuclear Generating Station, found several pints of water in an engine cylinder. This precautionary check allowed the licensee to avert severe engine damage. The licensee immediately stopped the surveillance, declared the EDG inoperable, and initiated a work order to determine the cause. After removing the cylinder module, the licensee found that a small leak path had slowly developed on the head gasket, allowing the jacket cooling water to intrude into the cylinder. The licensee had operated this engine 7 days earlier without difficulty. Apparently, a sufficient amount of fluid had leaked after this previous test to partially fill the cylinder with water. The licensee determined that if the EDG had been

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started on this occasion without first being checked for water in the cylinders, the EDG would have been severely damaged by hydraulic lockup of the cylinder. While performing a similar precautionary check in 1987, the licensee discovered a similar condition on a Unit 1 EDG that was caused by a cracked cylinder. Furthermore, an EDG at the Palo Verde Nuclear Generating Station was severely damaged in 1986 because it was started after water leaked into a cylinder through a cracked cylinder wall.

Discussion

Because of the incompressible nature of water and fuel oil, the presence of significant amounts of fluid in an engine cylinder can cause hydraulic lockup during the compression stroke. When the force from the starter and other firing cylinders tries to overcome this lockup, the engine could be severely damaged. The fluid can come from a number of sources such as a leaking head gasket, a cracked cylinder or head, or a defective fuel injector or lube oil system. EDG vendors such as Transamerica Delaval, Incorporated (TDI Instruction Manual, Volume 1, Model DSRV-20-4 Diesel Engine/Generator, page 4-2) and the General Motors Company, Electro-Motive Division (GM/EMD Scheduled Maintenance Program, Stationary Power Units with Turbocharged Engines, Maintenance Instruction 1728, Revision C, November 1977), have recognized the significance of this hazard and have recommended that their clients first check for fluid in the cylinders before starting the engine if the engine has been shut down and cooled for a prolonged period. The NRC has discussed this problem with experienced diesel engine operators and understands that this is also a common practice in non-nuclear industries.

To prepare the engine for each surveillance start, the operators at San Onofre lock out the engine's automatic-start feature, open the indicator petcocks (test valves) on all cylinders, and rotate the engine slowly to check for fluid in the cylinders. After verifying the absence of fluid in the cylinders, the operators start the EDG. The NRC conducted an informal survey of resident inspectors at plants of other NRC licensees and found that not all NRC licensees are following this practice, possibly because the EDG becomes temporarily inoperable while it is locked out with the cylinder petcocks open.

The NRC has also addressed this issue in its "Safety Evaluation Report Related to the Operability and Reliability of Emergency Diesel Generators Manufactured by Transamerica Delaval, Inc.," NUREG-1216, August 1986, beginning on page B-4, and in a contract study "Review of Resolution of Known Problems in Engine Components for Transamerica Delaval Inc. Emergency Diesel Generators," PNL-5600, December 1985, on page 4.160. These documents are available in the NRC Public Document Room at 2120 L Street N.W., Washington, D.C. 20555.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation project manager.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contacts: Andrew Hon, RV
(714) 492-2641

Peter Prescott, NRR
(301) 492-1011

Vern Hodge, NRR
(301) 492-1861

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-61	Preliminary Results of Validation Testing of Motor-Operated Valve Diagnostic Equipment	09/30/91	All holders of OLs or CPs for nuclear power reactors and motor-operated valve (MOV) diagnostic equipment vendors identified herein.
91-60	False Alarms of Alarm Ratemeters Because of Radiofrequency Interference	09/24/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.
91-59	Problems with Access Authorization Programs	09/23/91	All holders of OLs or CPs for nuclear power reactors.
91-58	Dependency of Offset Disc Butterfly Valve's Operation on Orientation with Respect to Flow	09/20/91	All holders of OLs or CPs for nuclear power reactors.
91-57	Operational Experience on Bus Transfers	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-56	Potential Radioactive Leakage to Tank Vented to Atmosphere	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-55	Failures Caused by An Improperly Adjusted Test Link In 4.16 KV General Electric Switchgear	09/16/91	All holders of OLs or CPs for nuclear power reactors.
85-18, Supp. 1	Failures of Undervoltage Output Circuit Boards In the Westinghouse-Designed Solid State Protection System	09/10/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
91-54	Foreign Experience Regarding Boron Dilution	09/06/91	All holders of OLs or CPs for pressurized water reactors (PWRs).

OL = Operating License
CP = Construction Permit

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To prepare the engine for each surveillance start, the operators at San Onofre lock out the engine's automatic-start feature, open the indicator petcocks (test valves) on all cylinders, and rotate the engine slowly to check for fluid in the cylinders. After verifying the absence of fluid in the cylinders, the operators start the EDG. The NRC conducted an informal survey of resident inspectors at plants of other NRC licensees and found that not all NRC licensees are following this practice, possibly because the EDG becomes temporarily inoperable while it is locked out with the cylinder petcocks open.

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*SEE PREVIOUS CONCURRENCES Document Name: INFO NOTICE - HON, HODGE

	D/DOEA:NRR	C/OGCB:DOEA:NRR	*RPB:ADM	D/DLPQ:NRR
	CERossi	CHBerlinger	TechEd	JWRoe
	09/ /91	09/ /91	09/17/91	09/ /91
*OGCB:DOEA:NRR	*RI/RV	*SC/RV	LPEB:DLPQ:NRR	C/LPEB:DLPQ:NRR
CVHodge	AHon	PJohnson	PPrescott	EWBrach
09/17/91	09/17/91	09/18/91	09/19/91	09/ /91

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OGCB:DOEA:NRR	RI/RV concurred by telephone	SC/RV concurred w cmts by telephone	LPEB:DLPQ:NRR	C/LPEB:DLPQ:NRR
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Carl H. Berlinger for
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	CERossi	CHBerlinger	TechEd	JWRoe
	09/ /91	09/23/91	09/17/91	09/ /91
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